A case study analysis of the criteria used for authentic evaluation of information technology students' progress on workplace-based work-integrated learning

SOPHIE MCKENZIE[1]
SHAUN BANGAY
KAREN YOUNG
Deakin University, Geelong, Australia

This study explores the evaluation of Information Technology (IT) students during and after their core-to-course work-integrated learning (WIL) placement conducted with an industry host and aligned for credit at an Australian University. The case study investigates the value of the performance evaluation criteria used by supervisors to judge students' placement progress and skill development. Understanding how students are reviewed during placements is a crucial assurance of learning for students, program managers, placement supervisors and teaching staff (academics). A comprehensive quantitative analysis of n=251 student placement reviews drawn across three teaching periods in 2021/22 provided insights into the effectiveness of each criterion. The results reveal the need for clarity and improvement of some criteria and a refinement of the overall process namely to improve quality feedback for students during their placement. The findings provide valuable contribution to sector-wide enhancement of IT placements with the aim of better preparing IT students for the world of work.

Keywords: Higher education, information technology, work-based WIL, supervisor evaluation, placement review criteria

In the past 10 years the graduate employment landscape in Australia has changed considerably, with an increase in the overall number of jobs available that require IT and digital skills. COVID-19 presented several challenges for the workforce, however recent data shows a recovery in employment outcomes and prospects across a large part of the Australian workforce (National Skills Commission, 2022). In the 2021 employment outcomes update, labor market growth shows that over the 2020-2021 period, 92% of total employment growth has been in occupations where some level of post-secondary school qualifications is usually required (Jobs and Skills Australia, 2023). The role of a software and applications programmer is predicted to have 27% growth, with 40% growth for both database and systems administrators, and cyber security specialists according to employment forecasts up to 2026 (National Skills Commission, 2022). Palmer et al., (2018) defined the job market for Australian IT bachelor graduates as dynamic and competitive, with strong competition from the global IT workforce, yet new graduates are finding it increasingly difficult to secure initial employment in the IT industry.

The overall domestic undergraduate employment outcomes have continued to improve since 2016 for the study area 'computing and information systems.' In 2023, domestic graduates in this study area, who were employed in managerial and professional occupations, was 84.4% (% of those employed full-time). The same group had a lower reporting for course preparation for their current job of 74.3% (Quality Indicators for Learning and Teaching, 2024). This data provides some insight – despite high employment outcomes for IT students – that there are curriculum opportunities to enhance graduate readiness by increasing the relevance between course content to employment destination. As such, an opportunity arises to uplift the workplace-based WIL curriculum (and particularly placement assessment) to better align performance criteria used for placement evaluations to graduate role activities. This should improve not only perceptions of relevancy (immediately post-graduation), but

[1] Corresponding author: Sophie McKenzie, sophie.mckenzie@deakin.edu.au

also to improve the readiness and thus success of graduates. This is supported by studies that highlight that the alignment of university assessments to industry requirements and expectations is critical to students' perceptions of authenticity (Ajjawi et al., 2020; Young et al., 2024).

To support students on their transition into the working world, many universities now offer, and sometimes mandate students complete a portion of their course within the workplace through a work-integrated learning (WIL) program (or also often called a placement or internship, and herein referred to as workplace-based WIL). In IT, there has been a considerable increase in the number of universities requiring students to do a placement, requiring industry to be responsive and accepting of taking on board students into their workplace (Palmer et al., 2018). Makhathini (2016) explored the skills development of engineering students based on five categories of workplace performance: ability, performance, judgement, attitude and suitability. The results show that most students meet the standard expectation on the cognitive or 'hard' skills but seem to lack the behavioral or 'soft' skills. In IT less is known about students' skill development while on placement, making it difficult to know how to assess students workplace performance as a part of their assessment aligned to placement. To this end, this study analyses the official performance reviews that IT students receive during and post placement, to gain insights into 1). how students are reviewed by industry/community hosts whilst on placement, and 2). if the performance review criteria are providing value for both the student and supervisor in determining performance.

LITERATURE REVIEW

Workplace-based WIL continues to be important to support the development of university students' employability (Mandal & Edwards, 2022). Alignment theory suggests that the assessment of WIL should include an assessment of students' demonstration of professional competence in the workplace (McNamara, 2013), including that of placement supervisor feedback as one source of the student's competence on placement (Boud et al., 2020; Jobs and Skills Australia2023). The supervision of students by placement supervisors is acknowledged as an important part of the work-integrated learning process (Rees et al., 2020; Winchester-Seeto et al., 2016).

When students reach university, it is sometimes assumed that they have the requisite skills to build career competencies, however recent research has shown this is not always the case. The results shown in McKenzie et al., (2017, 2018, 2021) demonstrate that IT students often have unrealistic skill expectations for their future employment, and are unaware of the best way to develop these skills during their time at university. During their studies students need to be made aware of the competencies expected in job roles and be cognizant of requirements for the careers that are of interest to them. Work-based WIL provides an opportunity for students in IT to build their self-efficacy regarding career interest and their skill development, helping to prepare them for the world of work (McKenzie et al., 2021). In IT, work-based WIL has become a compulsory requirement of many undergraduate courses in Australia (Department of Education, 2021). Yet, there is no clear model for assessing an IT students work-place performance while on placement, especially in relation to how to capture this information from industry placement supervisors.

The literature presents different models for reviewing and assessing student performance while on placement (Boud et al., 2020; Jeong & McMillan, 2015). The common thread is that the assessment model chosen should ensure that the student is able to achieve the planned/agreed set of learning outcomes and to ensure this, the model of feedback and performance evaluation should be a collaborative one with the industry/host (Ajjawi et al., 2020; Richardson et al., 2013). Students

documenting and reflecting upon their placement experience can draw upon their placement supervisor's feedback to understand achievement and skills development. Although, Nisbet et al. (2022) found that students are often their own worst critics, evaluating their placement performance below that of their placement supervisor. When assessing performance and learning during a placement experience, the moments where learning and performance meet is where good practice assessment design is most critical. Boud et al. (2020) describe this intersection of practice and assessment to provide "several purposes for stakeholders: for the educator, there is assurance of learning; for students, it can prompt and help articulate learning and skills; for industry partners, it can create products or artefacts and can contribute to production" (p. 1).

Industry involvement in the evaluation of student capabilities while on placement is critical. It contributes to student understanding and demonstration of learning and performance on placement. A multi-stakeholder evaluation of student performance specifically for WIL, is invaluable (Jackson, 2019a). Including a student-host-academic evaluation model to develop and measure student learning, not just performance, is invaluable in workplace-based WIL. Further, placement assessment supported by a placement supervisor can assist students in developing their professional identity (Jackson, 2019b). One of the ways to ensure the quality of this process is to align the process to a capabilities framework that can highlight the competencies that under development. The study from Jackson et al. (2023) highlights the need for an industry-aligned capabilities framework which aligns industry standards in workplace-based WIL to student learning. Their capabilities framework, irrespective of the actual criteria, highlights the competencies that count, such as when students interact, learn, and work and, therefore, need to perform to industry standards in workplace-based WIL (Jackson et al., 2023). Regardless of the criteria used, or the role of industry feedback (be it summative or formative, or both), the overall subject/ unit assessment structure is most effective when inclusive of different stakeholder judgements of performance and perceptions of learning. To best support IT students during their placement, more needs to be understood about how the industry placement supervisors can contribute to student understanding of their placement outcomes.

Findings relating to the value of assessment rubrics in workplace-based WIL units, when understood by teaching staff and industry practitioners alike, suggest a promotion of standards-based assessment (Kilgour et al., 2014) which provides a frame for guiding expectations of performance and learning how to judge student capabilities, while Milne and Caldicott (2016)) assert the value of the supervisor review towards judging of a student's placement. Other benefits include reliability of the grade (if summative results are needed), and just as importantly, that consistency of feedback on abilities and specific learning development areas was possible from both host and academic via the provision of an assessment rubric. Milne and Caldicott's (2016) exploration of the debates on whether industry supervisors/hosts input and feedback relating to student performance are reliable, suggest that the evaluation is equally as reliable as other traditional 'academic' modes of student assessment.

To become a professional within the IT discipline, members must achieve certain characteristics (Coldwell, 2008), which include: core body of knowledge, accreditation, skills development, certification, licensing, professional society registration, code of ethics and professional development. The Australian Computer Society (ACS) (2021) is the professional body that accredits IT courses in Australia, to ensure they produce professionals suitable to contribute to the IT industry. The ACS draws its professional framework from Skills Framework for the Information Age, a global skills and competency framework for the digital world (SFIA Foundation, 2021). The ACS describes two skill areas required for IT graduates: Professionalism in ICT and ICT core body of knowledge. Professionalism in ICT includes ethics, impacts of ICT on community/ society, working in teams,

communication, and legal frameworks for job participation (Australian Computer Society, 2021). Within the core body of knowledge, students also need to develop ICT role-specific knowledge as it relates to areas of IT, such as cyber security or computer science. Students must be given opportunities to develop their professionalism in ICT, and to apply and demonstrate competency in the skills and knowledge required of IT professionals in the workplace. Included in this are technical and non-technical skills. Zegwaard et al., (2003, p. 9) argue technically oriented placements can demonstrate ICT learning, because it "is socially mediated and thus assessment of learning must take into account the context, environment and objectives of the learning experience for individual learners." The performance review, therefore, must be part of the broader placement activities and the unit assessment structure to enable benchmarking of performance. It should be capable of encapsulating the nature of the placement experience, the academic requirements of the unit, an assurance of the skills and knowledge suitable to contribute to the IT industry, and student career aspirations, all of which inform a broader view of placement outcomes (Jeong & McMillan, 2015). A work-based placement performance evaluation that involves these elements can provide students useful guidance around their knowledge and skill development most likely to contribute positively to achievement of their career goals.

By using these benchmarks within the assessment design of a workplace-based IT unit, we can critically review student skill levels during the placement, so that we can better understand how to support student learning for their placement. Further to this, we can make an impact on work preparedness for post-graduation (Jackson, 2019a). To ensure IT students are ready for the workforce (Salm et al., 2023) this paper reports, via a case study approach, an understanding of how students are reviewed in their placement by their industry supervisor. A case study enables a detailed look at an issue in context, utilizing case specific details to help translate research outcomes (Creswell, 2013). This detailed look allows us to better understand the types and levels of skills that may require further curriculum support.

CASE STUDY: IT PLACEMENT AT DEAKIN

In this case study, the School of Information Technology at Deakin University, has been selected as the source for gathering performance reviews of IT students while on placement. Deakin is a major provider of distance and online education and teaches on-campus cohorts at five campuses located in three cities in the State of Victoria, spanning metropolitan, regional and rural locations, as well as internationally in a campus in India. Deakin University currently teaches on a trimester system, with three teaching periods per year of equal duration and status. The discipline of Information Technology rests within the Faculty of Science, Engineering and Built Environment. The School of Information Technology (SIT) offers undergraduate and postgraduate IT programs. The courses offered specialize in computer science, software engineering, networking, artificial intelligence, data analytics, cyber security and creative technology (games development, web and mobile applications). These programs are delivered in both on-campus and off-campus modes, with a focus on an industry and professional society informed curriculum, to nurture IT graduates. Deakin University aligns their course design to the Australian Computer Societies 'core body of knowledge' skills framework, resulting in the course offerings being accredited.

This case study is focused on a workplace-based WIL unit in the discipline of IT, for the undergraduate cohort. The unit is designed to prepare students for, and develop student expertise in, professional work-readiness. The unit is comprised of an approved placement activity in/with industry (100-150 hours) as well as teaching and assessment activities (up to 150 hours). The placement activity is a

compulsory part of an undergraduate student's course experience. Placements are a mix of paid and unpaid, conducted onsite, remote or in hybrid working conditions with a variety of industry hosts. All placements must ensure they contain an element of activities related to IT, such as web design and development, programming, networking, cyber security or similar.

During the placement, there are two designated 'performance' review phases, conducted by the industry supervisor responsible for supporting the student on placement – at the mid and end of placement phases. The review process includes a performance review template (see Appendix A) to enable an evaluation of the students' skill level, with a feedback mechanism to guide potential areas of development while on placement. This review template is made available to both student and host prior to the commencement of the placement. There are 14 statements on the performance review form (e.g., 1. Overall performance rating, e.g., 2. Professional and ethical behavior, 3. Attends work regularly and completes work commitments with a positive attitude etc.), each with a list of 4 or 5 statements, for selection of a single choice response. The skill questions and the possible responses in the evaluation template are aligned to the learning and assessment design for the associated academic unit that occurs alongside the placement experience. The performance review form is sent by the supervisor to the university for consideration as a part of the students' placement assessment. The student is provided with the review outcomes during and at the end of their placement. The review form is the same for the mid- and end-point of the students placement. The data captured at the mid- and end-review of a student's placement will not only inform skill level and supervisor expectations, but also inform students' skill development during their time on placement.

A supervisor performance review is designed to report on students' performance during the placement for the student to satisfactorily progress through the unit and complete the placement. Reviews do not contribute to the academic grading of the placement assessment component; however, supervisors provide critical feedback to the student and the academic on placement progress and associated work activities. A satisfactory performance review meets the hurdle assessment component of the unit, required for the satisfactory completion of a student's placement. This is an ungraded (formative) part of the assessment design of the unit. This was chosen due to the high volume of supervisors each teaching period in IT, and a need for each industry supervisor to commit time to consider not only performance requirements but also academic grading requirements as a part of a student's placement progress. Students are expected to incorporate informal supervisor feedback into their daily placement logs, along with reflections from their formal supervisor feedback obtained from their performance review. The portfolio assessment occurs alongside the student placement activity, following the general stages of pre-placement, during-placement and post-placement. All stages incorporate reflective practice, with the two supervisor performance reviews (mid and end of placement) functioning as an important check in and confirmation of placement learning. The performance review is captured in the during-placement assessment components, which consists of:

- Week one progress**:** A student self-reflection of their first week on placement. This includes any updates to the planned work tasks, along with the first entry to their placement logbook.
- Logbook start to mid: A detailed logbook, recorded by the student, on their workplace activities from the start of the placement up until the mid-point. The logbook utilizes Borton's 1969 reflective approach of 'what', 'so what', 'now what', asking students to report their placement activity, along with a reflection on any feedback they received while on placement and how this impacted their workplace performance. Students are also asked to consider their skill development more broadly, reflecting on how their current placement activities may contribute

to their future work performance, while also considering the impact of the placement on their career goals.

- Supervisor mid-review**:** The performance review form in Appendix A is provided to the workplace supervisor, with the outcomes reported back via the unit staff to the student. Students are requested to incorporate this feedback into the remainder of their placement experience and to reflect upon their feedback in the placement log. To be eligible to obtain a pass in this unit, students must demonstrate that they are working to the satisfaction of the supervisor/ host organization (including skill competency levels, professional code of conduct and project output requirements) at both the mid and end of professional experience (placement). More specifically, both mid and end professional experience (placement) performance reviews need to be deemed 'satisfactory' by the supervisor to achieve the pass level.
- Logbook mid to end**:** Students are asked to continue their logbook, capturing their placement experience from the middle of their placement, following receipt of a satisfactory performance review, until the end of their placement.
- Supervisor end-review**:** The performance review form in Appendix A is again provided to the workplace supervisor, with the outcomes reported back via the unit staff to the student. Students are requested to incorporate this feedback into post-placement activities.

The performance review criteria are designed for students to critically reflect on their performance to date and apply a feedforward mechanism for improving future actions.

During final grading of the student's portfolio assessment, the teaching staff member considers the supervisor's performance review comments and scores related to the student placement as a formative determinant of placement outcomes (the level of 'success'). In conjunction with this, the teaching staff member includes the student's reported placement outcomes as described in their logbook to inform the summative determination of their placement outcomes. While other studies have cited the relevance of using the supervisor's performance review as a formal part of a student's grading outcome (Ajjawi et al., 2020), this is not the case for IT placement. The industry supervisor is encouraged to focus on workplace performance and feedback, rather than on the assessment outcomes as a means of encouraging a productive and nurturing work environment for the student.

RESEARCH QUESTION

The following research question guides this study: What criteria provide value in understanding IT student's placement progress and skill development during and post placement? (R1)

METHODS

Data is collected from the reviews of student performance submitted by the industry supervisor. The reviews take the form of a survey that includes the following 14 criteria:

1. Overall performance rating
2. Professional and ethical behavior
3. Attends work regularly
4. Completes work commitments with a positive attitude
5. Work ethic
6. Time management
7. Communication

8. Position and opportunities
9. Networking
10. Taking feedback
11. Information technology skills
12. Self-awareness and integrity
13. Flexibility and negotiation
14. Reflective ability

Each criterion is responded to on a four-point or five-point Likert scale through a form-based software. The data was obtained from three consecutive teaching periods during one academic calendar year, between 2021 and 2022 and consists of all records submitted during this period.

The full set of questions on the performance review are shown in Appendix A. This research received ethics approval from the authors' institution under approval code: SEBE-2021-46.

The study used a survey method to capture how supervisors review students while on placement. A survey method was chosen as it integrated into the current placement assessment to capture a review of student performance by the industry supervisor. We have captured a total of n=251 placement performance reviews completed mid or end of placement, to gain a sufficient data set for enabling analyses of reported skill levels. The data was obtained from three consecutive teaching periods during one academic calendar year, between 2021 and 2022. Of the 251 performance reviews, 33 supervisors provided mid and end review for more than one student, indicating their involvement in the WIL program beyond supporting one student. Quantitative analysis, including correlation and principal component analysis, was conducted on the data collected to determine how performance reviews provide information to students, and the academic team who supervise the students. Nisbet et al. (2022) used a quantitative comparison approach in their study to compare how students rated themselves compared to their supervisors.

In our case study, the value of each of the criteria are analyzed using the following process. Reduced utility of a criterion can result where it fails to provide a meaningful measure, or where the measurement scale is saturated and cannot distinguish between different levels of achievement. Summary statistics are used to identify these cases. A criterion whose range (min to max) covers less than the full scale is likely to be measuring outcomes that cannot be achieved. A distribution that differs significantly from a normal distribution centered around the mid-range of the scale indicates that the criterion is either biased or does not clearly distinguish different levels of performance. For example, a standard deviation much less than 1 suggests that the criterion is a 'compliance check' and could be replaced with a Boolean yes/no value as the vast majority of supervisors are unable to assess subtle variations in the associated attribute. A mean/median close to a minimum or maximum value indicates the measure is saturated and that either the scale needs to be extended, or the criteria rephrased to allow different levels of achievement to be distinguished.

Different criteria also need to avoid duplication since each additional criterion represents extra effort and contributes towards survey fatigue. Potential duplication may be identified using correlation with the Kendall rank correlation coefficient (τ) which is suited to the Likert scale encoding. Low correlation between criteria indicates low levels of duplication as the criteria measure different properties. High correlation suggests the criteria are just alternative measures of the same thing. High correlation is expected between the mid- and end-placement values for each criterion and would indicate that the student is performing consistently.

Correlation identifies cases where supervisor scores for one criterion gives similar scores for another criterion. This can be triggered by behaviors such as all supervisors giving the same score to both criteria. We do need to distinguish correlation resulting from poor criteria from correlation resulting from both criteria measuring the same thing. The information associated with the scores for each criteria can distinguish these. This can be quantified using Shannon entropy. A scale with n values would typically have an entropy of $\log_2 n$ (roughly 2 to 2.3 for 4 and 5 valued Likert scales). Lower values indicate that the criterion is not being used effectively. Mutual information compares two criteria and identifies how much of the information present in one criterion is already present in the other. Large amounts of mutual information are evidence of a degree of duplication in criteria. When duplication is detected, the corollary to R1 is to ask what criteria should be used to provide the required value. This can be phrased as a dimensionality reduction problem, to reduce the data set to a form where the results can be recreated with a smaller set of (different) criteria. Principal component analysis (PCA) produces a new set of synthetic criteria in an order that captures the variation in the data set, from most significant to least significant. Typically, for some value of n, the first n components will be sufficient to recreate a large percentage of the data.

RESULTS

We have captured a total of n=346 placement performance reviews completed mid or end of placement, to gain a sufficient data set for enabling analyses of reported skill levels. Of the 251 supervisors who provided performance reviews, 33 supervisors provided mid and end review for more than one student, indicating their involvement in the WIL program beyond supporting one student. The same supervisor provided both mid and end placement reviews in all but 8 cases. Some students received only one 1 review (44 only mid placement, 27 only end placement). These partial records are only used where they do not affect the analysis. Anomalous data was manually removed (e.g., where a student apparently completed their own performance review).

The following describes the dataset collected through a presentation of the descriptive statistics (Table 1 and 2). The questions in the evaluation form ask the supervisor to rate the student on a number of behavioral (e.g. work ethic) and skills-based criteria (e.g. communication and technical skills). Each criteria is responded to on a four-point or five-point Likert scale through a form-based software. The full set of questions on the performance review are shown in Appendix A.

TABLE 1: Mid-review descriptive statistics.

Criteria	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
min	0	1	1	1	0	0	0	1	0	0	0	0	0	0
max	3	3	3	3	4	4	4	4	4	4	4	4	4	4
range	3	2	2	2	4	4	4	3	4	4	4	4	4	4
median	2	3	3	3	3	3	2	3	2	2	3	3	2	3
mean	2.32	2.86	2.62	2.72	2.77	2.68	2.38	2.59	2.39	2.62	2.77	2.51	2.43	2.70
Standard deviation	0.683	0.385	0.597	0.5234	1.0218	1.2315	0.9661	0.9349	0.8692	1.0610	1.193	1.0338	1.0548	1.0564

TABLE 2: End-review descriptive statistics.

Criteria	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**
min	0	1	1	1	0	0	0	1	0	0	0	0	0	0
max	3	3	3	3	4	4	4	4	4	4	4	4	4	4
range	3	2	3	2	4	4	4	3	4	4	4	4	4	4
median	3	3	3	3	3	3	3	3	2	3	3	3	3	3
mean	2.42	2.87	2.67	2.74	2.90	2.92	2.64	2.83	2.57	2.80	2. 7	2.72	2.68	2.98
Standard deviation	0.6987	0.3657	0.5626	0.4904	1.0113	1.0984	0.9634	0.8588	0.8924	1.0354	1.1046	1.0251	1.0366	1.0518

Based on the results shown in Tables 1 and 2, criteria one to four can be considered as 'compliance checks' due to the low variance/deviation in the mean and standard deviation, and limited use of the range of answers. Criteria one provided an overall judgement of a student's placement performance. Criteria two queried whether the student followed the company's code of conduct and confidentiality agreement. Criteria three queried whether students complete work in a timely fashion. With criteria four querying whether students complete the work with a positive attitude.

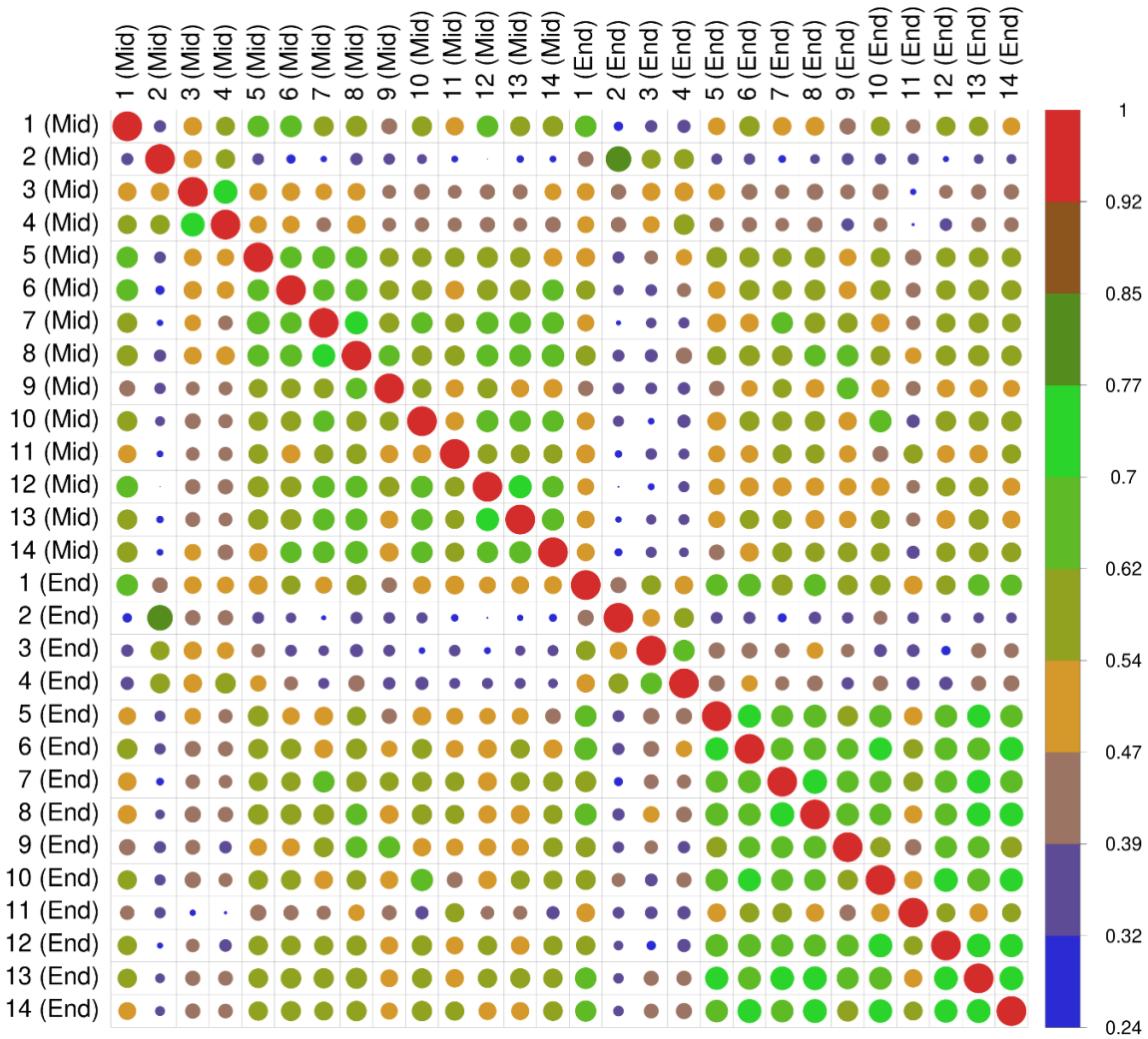
On the other end, high deviation from the mean and greater use of the range of answers indicates more value in the criteria for assessing students' skill development while on placement. Criteria 11 that queried the students IT skills while on placement indicates consistently high values across both mid- and end-reviews. This may suggest further granularity is required for this performance review criteria, to ensure progression in IT skills from the mid review to the end review can better documented via the performance review process. Further, criteria eight on time management and criteria 14 on reflective practice have high peak values, indicating that additional higher scales may be needed, or greater range of options required, to capture differences in student performance.

To address research question one (R1), we set out to investigate if there were criterion (of the 1-14 criteria categories) that were valuable for supervisors to make informed judgements about student's placement performance in terms of skill application, at the mid and end of placement. We also wanted to understand if there was a difference in the scoring between the mid and end performance review. The way we set out to determine the value was by understanding if there is a correlation between the mid and end reviews provided by supervisors. Extending upon the descriptive statistics presented, we used a correlation analysis to determine the relationship between the performance review criteria, with the results shown in Figure 1. The performance review criteria are listed above and on the left axis, with the right Y axis showing a colored bar to indicate the degree of correlation, with 1 indicating perfectly correlated performance review criteria.

Some criteria (2-4) have a low correlation with the remainder, including criterion 1 that represents an overall assessment of the student. This is consistent with the previous results that suggest these criteria are related to a compliance check rather than actual performance. Further, the mid-mid and end-end correlations are larger than mid-end or end-mid. This suggests that supervisor ratings tend to be more consistent between criteria within the same rating period, rather than being consistent across students

between the two rating periods. Thus, the criteria measure properties of the rating period (student achievement at that point) rather than something fundamental about the criterion. This suggests there are a smaller set of criteria that would have less overlap. Visual inspection suggests criteria 5-10 and 12-14 all overlap, potentially representing difficulty in distinguishing between the various dimensions related to professional skills. These are distinct from criterion 11 in the end-review which measures student IT skills. Given the nature of the experience further consideration is needed in relation to what this criterion is measuring.

FIGURE 1: Correlation analysis between review criteria.



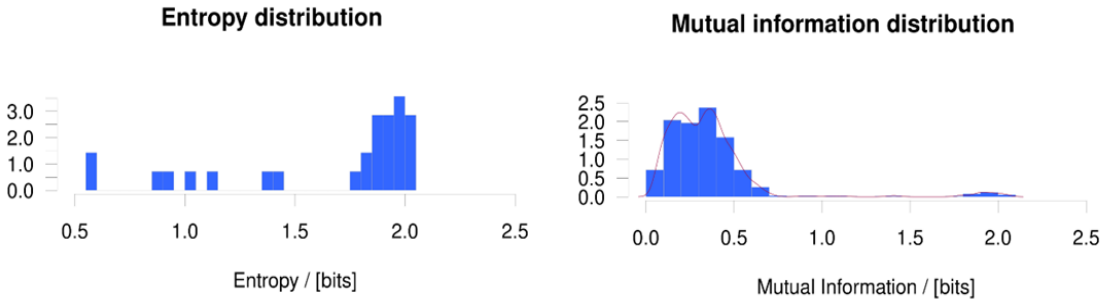
Note. The performance review criteria are listed above and on the left axis, with the right Y axis showing a colored bar to indicate the degree of correlation, with 1 indicating perfectly correlated performance review criteria.

Figure 2 provides a visualization of the performance review criteria, demonstrating grouping of performance review criteria based on their entropy and mutual information. Most criteria have an

entropy close to 2 indicating that the data for those criteria uses the full information capacity within the scale. The exceptions are criteria 1 using 1.4 bits, and criteria 2-4 using less than 1.1 bits. Criteria using less than 1 bit can be discarded as worthless, while those using ~1 bit could be recoded as a check box.

Mutual information shows two clusters. The cluster on the right represents information between a criterion and itself and can be ignored. The cluster on the left indicates that between 0 and 0.7 bits of information are common to different pairs of criteria suggesting overlap and opportunities to further distinguish them.

FIGURE 2a: Distribution of review criteria based on entropy and 2b: Mutual information.



To explore the overlap further, principal component analysis (PCA) was used investigate the principal axes that best describe the criteria that students are evaluated on. The PCA results demonstrate that the first component (Principal Component 1) covers 51% of the variance in performance reviews, with 90% of the variance being achieved by the first 8 principal components. Thus it is theoretically possible to achieve 90% of the supervisor review using only 8 fields, rather than the 28 (2 × 14) used at present. Figure 3 shows a bi-plot with the existing criteria projected on the first 2 principal components and sufficiently representing 66% of the current data set. The plot suggests that the first component distinguishes between criteria clusters 2-4 and 1, 5-14, potentially measuring compliance versus performance. The second principal component distinguishes mid and end reviews, representing a new criterion corresponding to time of review. It is disturbing that the actual performance levels of the student are not reflected in these two largest components.

FIGURE 3: Bi-plot of PCA for mid and end-review.

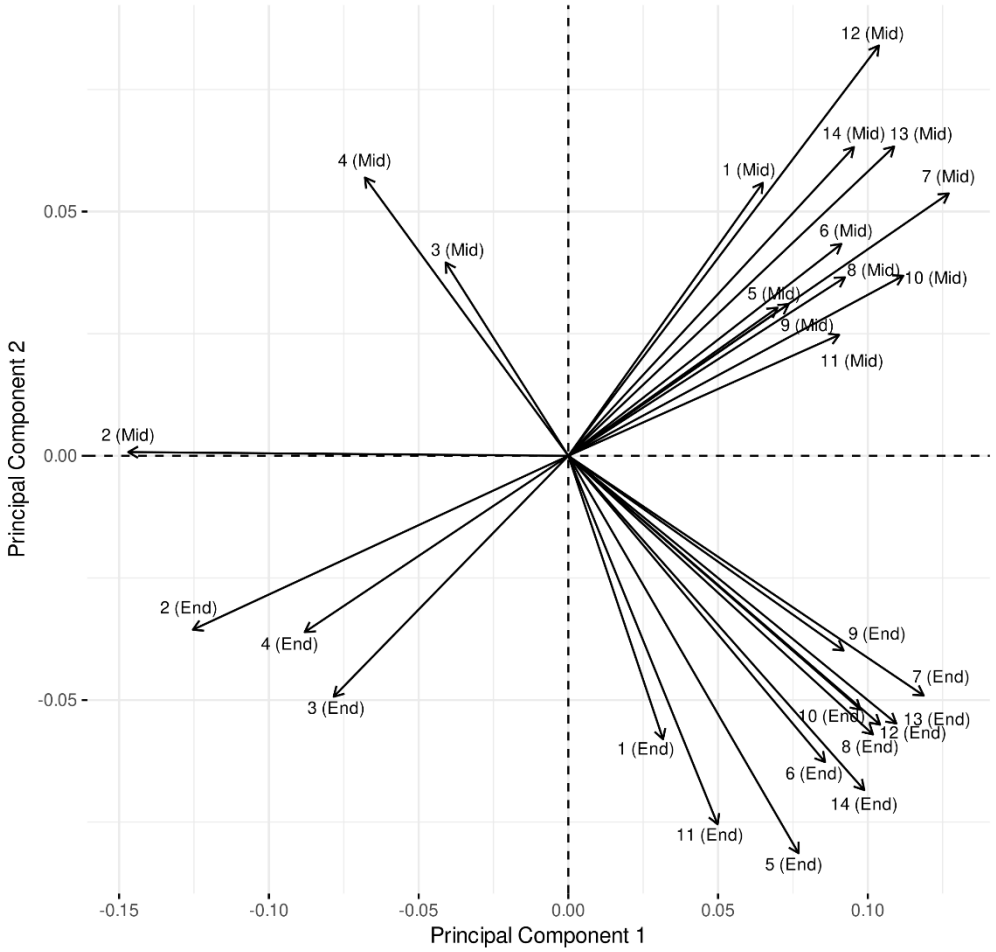


Figure 3 demonstrates performance review criteria grouping, demonstrating criteria overlap. In the mid-review, behavioral skills that relate to work ethics overlaps with the ability to network and work with others. In the end-review, communication skills overlap with role in the team, flexibility overlaps with self-awareness and self-reflection. Also, IT skills tend to lie on one edge suggesting it is furthest from the other performance criteria, and thus most distinct. Interestingly, the overall end-review performance (criteria one) level is close to this, suggesting performance is potentially dominated by IT skills (criteria 11) rather than the other criteria.

DISCUSSION

The results indicate value in understanding IT student's placement progress and skill development during mid- and end- performance reviews. In table 1 and 2, the descriptive statistics show an

improvement in the mean for performance review results between the mid- and end-review. The improvement in mean suggests that the supervisors are reviewing the form consistently to provide the review and that students are improving. The outcomes could also suggest that placement supervisors feel the need to provide the students with a positive final evaluation. McNamara (2013) comments on the disconnect that can occur between a placement supervisor review and the student learning outcomes as documented in their assessment. Further, the analysis showed the mid- and end-review criteria have some similarities but with minor changes to their make-up. This could lead to different descriptions for mid- and end-reviews to be created, or the performance review criteria could be standardized across the reviews.

Further analysis showed how some of the performance criteria were correlated, with IT skills being associated with overall performance review at the end of a student's placement. Through correlation and PCA analysis, we find that some fields in the performance review are compliance checks, limiting the performance level that can be derived from these criteria. These criteria need to be managed via a different process or replaced with more assessable criteria to provide value for both student and supervisor to inform placement performance. Overall, the analysis showed that a reduced set of criteria for the behavioral or soft skills and a simplified numerical scale to indicate student performance could be implemented. While Jackson et al. (2023) argues that any review criteria can be useful to understand placement performance, having a clear and repeatable review structure will help students, supervisors and academic staff to easily understand and administer a review of a student's placement. Further as Makhathini (2016) found, valuable structures for evaluating the 'soft skills' of IT students are needed to ensure they are meeting the expected industry standards. Based on our analysis, the performance review structure can reduce to focus on team work over 'work ethic' and the 'ability to network and work with others.' Furthermore, review criteria related to flexibility can be combined with self-awareness and self-reflection to focus on adaptability while on placement.

Overall, the results from review of students on IT placement demonstrates that supervisors are using the performance review criteria to rate the student, rather than providing a value that only depends on the criterion (e.g. a value that they ascribe to the criterion). This indicates that the criteria do include meaningful measures of student ability at each stage, enabling challenges to be determined in student's placement performance. When it comes to performance outcomes in relation to the assessment, the broad criteria of 'overall performance rating' determines if there has been challenges in students work-place activities that need to be responded to by the unit staff. Essentially, only those who receive an unsatisfactory performance review from their supervisor have their placement performance queried by the unit staff. All students who are satisfactory and above are asked to make their own inferences based on the placement review provided.

The descriptive statistics in Table 1 and 2 demonstrate an overall improvement in placement performance from 'good' in the mid-review, to 'outstanding' in the end-review. However, this criterion does not enable challenges with the students work-place performance to be easily identified by both the student and unit staff, as any review ultimately deemed satisfactory is considered suitable performance. While further granularity could be provided in the performance review form, our analysis does not indicate this would not provide an improved understanding of student performance. Rather, an important take-away from our analysis of the performance review criteria is that the criteria should be adjusted to highlight where there is a clear difference in the criteria, initially by reducing and transferring those criteria that are being utilized as compliance checks (one to four) into a simpler structure. For the criteria that reviewed the students' performance (criteria five to 14), again the number of criteria available could be reduced, with expanded criteria to address discipline specific skills (IT)

and a reduced set of criteria that relate to behavioral skills, such as adaptability, consultation and communication. Further, the organization of the performance review criteria on the feedback form should be considered, avoiding placing criteria that share mutual information next to one another on the review form. For IT, consideration of the Skills Framework for the Information Age (SFIA Foundation, 2021) and the Australian Computer Society (2021) core body of knowledge could inform the discipline specific criteria, while also contributing to an industry standard assessment framework.

CONCLUSION AND FUTURE WORK

In conclusion, this investigation into IT student placement performance reviews, not only provides insights into where the process is most effective, but also highlights areas for improvement. The data indicate a notable improvement in the average performance review scores from mid-placement to end-placement, suggesting either genuine student progress, increased supervisor comfort in providing positive assessments, or a tendency for supervisors to adjust their feedback towards favorable final evaluations. While the performance review criteria effectively capture some aspects of student ability, they do not always clearly differentiate between satisfactory and subpar performance, especially when it comes to identifying and addressing challenges. This limitation suggests that the performance review system could benefit from a more streamlined and precise set of criteria. Specifically, separating compliance-related criteria from those assessing actual performance and reducing the number of criteria to focus on key areas—such as discipline-specific skills and essential behavioral competencies—could enhance the clarity and utility of the feedback provided. Additionally, reorganizing the performance review feedback form to avoid clustering similar criteria together could improve the coherence of the assessment. By implementing these changes, the performance review process could become a more effective tool for both identifying challenges in student performance and guiding their development throughout their placement. A revised review process can better direct a student in an assessment of their skills and effort on placement, while also offering a clarity to skills requiring improvement. Lastly, a revised performance review form can ask for less effort from the placement supervisor, better utilizing their feedback in a verified review process.

This research is limited in that it is focused on a single case study site at one institution. In addition, only placement supervisor reviews were captured and analyzed. No comparison with how the students reviewed themselves was provided as a datapoint in this study. By understanding how both supervisors and students use the performance review as a part of their work-based WIL, more can be learned about the efficacy of the review process on informing student placement outcomes. More research is required to understand how the performance review process impacts upon students learning gains, and how the review activity impacts student's understanding of their placement performance. More broadly, having common criteria for evaluating the performance of students on placement will help universities identify skill deficiencies in students as they relate to working in IT. This will enable universities to respond to the skill requirements through their course offerings.

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APPENDIX A: Supervisor review form.

Required to be completed at the mid and end point for each student's placement.

All answers were provided as a single choice.

Overall performance rating

1. Overall performance of the intern at the present time.
   - Unsatisfactory
   - Satisfactory
   - Good
   - Outstanding

Professional and Ethical Behaviour

2. Follows the company's code of conduct and confidentiality agreement.
   - Never
   - Some of the time
   - Most of the time
   - All the time

3. Attends work regularly and completes work commitments in a timely fashion.
   - Never
   - Some of the time
   - Most of the time
   - All of the time

4. Attends work regularly and completes work commitments with a positive attitude.
   - Never
   - Some of the time
   - Most of the time
   - All of the time

Engagement

5. Intern's work ethic
   - Seldom demonstrates this ability and rarely meets expectations.
   - Accepts and completes allocated work.
   - Accepts allocated work, completing it to high standards, in an acceptable timeframe.
   - Shows initiative by taking ownership of work and meeting deadlines.
   - Takes ownership of work and identifies novel ways to add value.

Time Management

6. Intern's time management
    - Seldom demonstrates this ability and rarely meets expectations.
    - Plans a schedule to complete allocated work in a timely manner.
    - Plans a schedule, reviews it regularly and adapts to meet timelines.
    - Reviews relative importance of tasks to manage timelines.
    - Has clear goals and regularly evaluates how tasks will impact the achievement of goals.

Communication

7. Intern's communication skills
    - Seldom demonstrates this ability and rarely meets expectations.
    - Can communicate in a professional manner.
    - Communicates in a professional manner in the correct context (language, tone, tools, and timing).
    - Uses different modes of communication to pitch new ideas, provides recommendations, and motivates others.
    - Identifies ways of using communication to advance the organisation.

Position and Opportunities

8. Intern's ability to understand the role in the team and/or organisation.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Understands the role in the team and/or organisation at a basic level.
    - Understands the role and its context within the organisation, and the opportunities it provides.
    - Fulfills the role and engages with related roles, making the most of the opportunities provided by their role in the organisation.
    - Identifies new relevant and related opportunities to help advance the organisation.

Networking

9. Intern's ability to network and interact with others.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Interacts with the supervisor.
    - Interacts with supervisor and wider team and is engaged in the networking process.
    - Demonstrates a high level of interaction with external & internal stakeholders, actively seek opportunities to connect.
    - Attends events outside the organisation and collaborates with external parties.

Taking feedback

10. Intern's ability to learn from feedback.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Accepts constructive feedback.
    - Accepts and responds to constructive feedback.
    - Identifies areas and stakeholders to seek feedback from.
    - Incorporates feedback into their career planning.

Information Technology Skills

11. Intern's IT skills.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Can demonstrate use of IT skills (use of digital tools) expected of new graduates within their field.
    - Uses company training to gain new IT skills needed for their role.

- Seeks external opportunities to gain relevant IT skills needed for their role.
- Confidently applies their IT skills & knowledge to advance the role/organisation.

Self-Awareness and Integrity

12. Intern's self-awareness and work integrity.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Demonstrates awareness of personal characteristics. Identifies personal strengths and weaknesses.
    - Demonstrates awareness of personal characteristics. Identifies personal strengths and weaknesses and their impact on others.
    - Identifies self and other's strengths and weaknesses and plans/behaves in ways that improve outcomes for everyone.
    - Identifies standout strength and use this to develop a personal brand within the context of the placement or organisation.

Flexibility and Negotiation

13. Intern's flexibility and negotiation skills so far.
    - Seldom demonstrates this ability/rarely meets expectations.
    - Confirms with industry supervisor the main outcome/goal(s) for the placement.
    - Discusses and agrees with industry supervisor on the goal(s) that is relevant, achievable and valuable to both parties.
    - Considers different perspectives and the implications of work/events for all stakeholders.
    - Identifies challenges/mismatches and find innovative ways to suit all stakeholders.

Reflective Ability

14. Intern's ability to reflect on their own performance and experiences.
    - Seldom demonstrates this ability and rarely meets expectations.
    - Looks back and learns from experience.
    - Applies learnings from reflections on experiences to improve future performance and/or behaviours
    - Identifies areas for reflection and analysis; plans and takes action for improvement.
    - Identifies areas for reflection and analysis; plan and take action for improvement.
    - Identifies personal values, feelings or beliefs and reflects on how these impact on actions.

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About the Journal

The International Journal of Work-Integrated Learning (IJWIL) publishes double-blind peer-reviewed original research and topical issues related to Work-Integrated Learning (WIL). IJWIL first published in 2000 under the name of Asia-Pacific Journal of Cooperative Education (APJCE).

In this Journal, WIL is defined as:

> *An educational approach involving three parties – the student, educational institution, and an external stakeholder – consisting of authentic work-focused experiences as an intentional component of the curriculum. Students learn through active engagement in purposeful work tasks, which enable the integration of theory with meaningful practice that is relevant to the students' discipline of study and/or professional development* (Zegwaard et al., 2023, p. 38*).

Examples of practice include off-campus workplace immersion activities such as work placements, internships, practicum, service learning, and cooperative education (co-op), and on-campus activities such as work-related projects/competitions, entrepreneurships, student-led enterprise, student consultancies, etc. WIL is related to, and overlaps with, the fields of experiential learning, work-based learning, and vocational education and training.

The Journal's aim is to enable specialists working in WIL to disseminate research findings and share knowledge to the benefit of institutions, students, WIL practitioners, curricular designers, and researchers. The Journal encourages quality research and explorative critical discussion that leads to the advancement of quality practices, development of further understanding of WIL, and promote further research.

The Journal is financially supported by the Work-Integrated Learning New Zealand (WILNZ; www.wilnz.nz), and the University of Waikato, New Zealand.

Types of Manuscripts Sought by the Journal

Types of manuscripts sought by IJWIL is primarily in two forms: 1) *research publications* describing research into aspects of work-integrated learning and, 2) *topical discussion* articles that review relevant literature and provide critical explorative discussion around a topical issue. The journal will, on occasions, consider good practice submissions.

Research publications should contain; an introduction that describes relevant literature and sets the context of the inquiry. A detailed description and justification for the methodology employed. A description of the research findings - tabulated as appropriate, a discussion of the importance of the findings including their significance to current established literature, implications for practitioners and researchers, whilst remaining mindful of the limitations of the data, and a conclusion preferably including suggestions for further research.

Topical discussion articles should contain a clear statement of the topic or issue under discussion, reference to relevant literature, critical and scholarly discussion on the importance of the issues, critical insights to how to advance the issue further, and implications for other researchers and practitioners.

Good practice and program description papers. On occasions, the Journal seeks manuscripts describing a practice of WIL as an example of good practice, however, only if it presents a particularly unique or innovative practice or it was situated in an unusual context. There must be a clear contribution of new knowledge to the established literature. Manuscripts describing what is essentially 'typical', 'common' or 'known' practices will be encouraged to rewrite the focus of the manuscript to a significant educational issue or will be encouraged to publish their work via another avenue that seeks such content.

By negotiation with the Editor-in-Chief, the Journal also accepts a small number of *Book Reviews* of relevant and recently published books.

Reference
Zegwaard, K. E., Pretti, T. J., Rowe, A. D., & Ferns, S. J. (2023). Defining work-integrated learning. In K. E. Zegwaard & T. J. Pretti (Eds.), *The Routledge international handbook of work-integrated learning* (3rd ed., pp. 29-48). Routledge. https://doi.org/10.4324/9781003156420-4

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